REMARKS

Claims 1 and 4-17 are pending in the Application prior to the amendments herein, and are rejected.

Claims 1, 6 and 13 are amended herein.

Claims 5 and 7 are cancelled herein.

Claim 63 is added herein.

Claims 1, 4, 6, 8-17 and 63 are pending after entry of the amendments herein.

1. Rejections Under 35 U.S.C. §103(a) over Smalley in view of Kawamura

The Examiner has rejected Claims 1, 5-6 and 12 under 35 U.S.C. § 103(a) as being unpatentable over Smalley et al., U.S. Patent 6,683,783 B1 ("*Smalley*") in view of Kawamura et al., U.S. Patent 6,706,431 B2 ("*Kawamura*"). Office Action at page 2.

Applicant respectfully traverses the rejection.

Claim 1 has been amended to contain limitations from original claims 5, 7, and 13. The claim as amended requires, *inter alia*, that the catalyst metal comprises platinum and further requires that "the catalyst metal is present in an amount less than 400 $\mu g/cm^2$ of the planar area of the mat of the carbon nanotubes, and wherein the electrode provides greater than 1 mA/cm^2 per μg Pt/cm^2 of the planar area of the mat of carbon nanotubes." Applicant has also amended Claim 1 to require that the single-wall carbon nanotubes have a diameter of about 0.7 – 3.5 nm. The amendments are supported in the specification at page 11, lines 7-8, and in original claims 5, 7, and 13.

In view of these amendments, Claims 5 and 7 are cancelled herein. Rejection of these claims is now moot. Claim 13 has been amended herein to delete the limitations that are hereby incorporated herein into Claim 1.

The Examiner states that *Kawamura* teaches the use of carbon nanotubes in fuel cell electrodes, and *Smalley* discloses single wall nanotubes. The Examiner further states that it would be obvious to use the single wall nanotubes of *Smalley* in the fuel cell electrodes of *Kawamura*, to derivatize the nanotubes with functional groups as disclosed in *Fisher*, and to use the catalyst loading and current density disclosed by *Hampden-Smith*. Applicant contends that this is not a proper combination of references.

In order to make a proper rejection under § 103(a), the Examiner should identify "an apparent reason to combine the known elements in the fashion claimed . . . ." *KSR International Co. v. Teleflex Inc.*, 127 S. Ct. 1727, 1741, 2007 U.S. LEXIS 4745, 82 U.S.P.Q.2d 1385 (2007). Applicant contends that there is no proper reason to do so in this case, because of the differences in the teachings of *Fisher* and *Hampden-Smith* as compared to those of *Smalley* and *Kawamura*.

Kawamura mentions the use of carbon nanotubes in fuel cell electrodes (see column 3, lines 42-48), but does not describe the nature of the nanotubes. *Smalley* discloses single wall carbon nanotubes. (See column 2, lines 30-34.)

However, *Fisher* is directed to an entirely different type of nanotubes than those disclosed in *Smalley*. The use of phrases such as "interior layers of the nanotube" and "outermost layer of the nanotube" (see column 5, lines 31-37 in *Fisher*) make it clear that the nanotubes in that reference are multi-wall nanotubes, not single wall nanotubes. This is significant because of the difference in properties between the two types of nanotubes.

Multi-wall nanotubes are composed of many, generally cylindrical, concentric carbon layers. Because of their multiple layers and the interconnections between these layers, they can withstand much more rigorous chemical processing (such as what occurs during functionalization and derivatization), physical conditions, and extensive chemical bond breakage without the nanotube destruction that can often, and more easily, occur with single-wall carbon nanotubes. Because of these significant differences between single-wall carbon nanotubes and multiwall carbon nanotubes, one of ordinary skill at the time of the invention would have no reason to modify the teachings of *Smalley* and *Kawamura* with those of *Fisher*.

Hampden-Smith also differs in an important way. The Examiner points to paragraph 109 of that reference for its teaching regarding carbon nanotubes. However, the teachings of that paragraph relate to the embodiment of paragraph 108.

> [0108] A further class of catalysts that can be useful according to the present invention are those derived from molecular compounds that can be self-supported or can be dispersed on a support phase. Examples of such materials are metal porphyrin complexes that catalyze the reduction of O_2 to OH^- but are oxidized during the oxidation of OH^-. These species are suitable for fuel cells such as alkaline fuel cells. Included in this group are metal porphyrin complexes of Co, Fe, Zn, Ni, Cu, Pd, Pt, Sn, Mo, Mn, Os, Ir and Ru. Other metal ligand complexes can be active in these catalytic oxidation and reduction reactions and can be formed by the methods described herein. Such metal ligands can be selected from the class of N4-metal chelates, represented by porphyrins, tetraazulenes, phtalocyanines and other chelating agents. In some cases the organic ligands are active in catalyzing reduction and oxidation reactions. The ligands can be active when they remain intact, as might be the case for an intact porphyrin ring system, or they can be partially reacted during thermal processing to form a different species that is active in the catalytic reactions. An example of the latter is the reaction product derived from porphyrins or other organic compounds.
>
> [0109] Carbon is required for the reduction of O_2 to OH^- and is believed to be involved in the reduction of peroxide to hydroxide ion. Other carbon based active species include homo- and hetero-fullerene and carbon nanotube based materials.

One of ordinary skill in the art would not look to metal porphyrin complexes like those taught in *Hampden-Smith* to modify the teachings of *Smalley* or *Kawamura.*

Furthermore, *Hampden-Smith* teaches a larger, substantially spherical electrocatalyst powder based on "primary carbon particles having an average particle size of from about 10 to about 100 nanometers." (*Hampden-Smith,* Paragraph 0028.) *Hampden-Smith* repeatedly teaches that both the powders and aggregates of such powders are substantially spherical. (See below.)

> One of the major advantages of the electrocatalyst powders described here is that that ***morphology (spherical),*** aggregate size and aggregate size distribution is controlled by the droplet size and size distribution during powder production."
>
> (*Hampden-Smith*, Paragraph 0102, emphasis added.)
>
> According to another embodiment of the present invention, a membrane electrode assembly is provided including at least an anode, a cathode and a membrane separating the anode and cathode, wherein at least one of the anode and cathode includes composite electrocatalyst aggregates having an active species dispersed on a support phase wherein ***the aggregates are substantially spherical*** and wherein the volume average size of the aggregates is not greater than about 100 μm.
>
> (*Hampden-Smith*, Paragraph 0029, emphasis added.)
>
> According to another embodiment of the present invention, a membrane electrode assembly is provided including an anode, a cathode and a membrane separating the anode and the cathode, wherein at least one of the anode and the cathode includes an electrocatalyst layer and the electrocatalyst layer includes ***substantially spherical electrocatalyst particles***.
>
> (*Hampden-Smith*, Paragraph 0031, emphasis added.)

Claim 1 of the present application requires a "mat of carbon nanotubes," which is neither an aggregate of spherical particles, nor is itself spherical. Claim 1 further requires that the single-wall carbon nanotubes have a diameter in the range of about 0.7 nm to about 3.5 nm. In contrast to *Hampden-Smith*, the single-wall carbon nanotubes of Claim 1, by their nature, are not substantially spherical, nor do they have the particle size taught by *Hampden-Smith*. In teaching

the use of substantially spherical particles having an average particle size of from about 10 to about 100 nanometers, *Hampden-Smith* teaches away from the present invention.

There is no apparent reason for a person of ordinary skill in the art to modify the teachings of *Smalley* or *Kawamura* with the teachings of *Fisher* or *Hampden-Smith*. Therefore, Claim 1, as amended, is not *prima facie* obvious.

Claims 6 and 12 are dependent upon amended Claim 1 and are not *prima facie* obvious for the same reasons.

In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 1, 6 and 12 under 35 U.S.C. § 103(a).

2. Rejections Under 35 U.S.C. §103(a) over Smalley in view of Kawamura and further in view of Fisher

The Examiner has rejected Claim 4 under 35 U.S.C. § 103(a) as being unpatentable over *Smalley* in view of *Kawamura* as applied to Claims 1, 5-6 and 12 above, and further in view of Fisher et al., U.S. Patent 6,203,814 ("*Fisher*"). Office Action at page 3.

Applicant respectfully traverses the rejection.

Claim 4 is dependent upon Claim 1, which is nonobvious for the reasons discussed above. Therefore, Claim 4 is not *prima facie* obvious for the same reasons.

In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claim 4 under 35 U.S.C. § 103(a) as being unpatentable over *Smalley* in view of *Kawamura* and further in view of *Fisher*.

3. Rejections Under 35 U.S.C. §103(a) over Smalley in view of Kawamura and Hampden-Smith

The Examiner has rejected Claims 7-11 and 13-17 under 35 U.S.C. § 103(a) as being unpatentable under 35 U.S.C. § 103(a) over *Smalley* in view of *Kawamura*, as applied to Claim 1, 5-6 and 12 above, and further in view of Hampden-Smith et al., U.S. Patent Publication 2003/198849 ("*Hampden-Smith*"). Office Action at page 4.

Applicant respectfully traverses the rejection.

Applicant has cancelled Claim 7 herein; therefore, the rejection of this claim is now moot.

As noted above, Claim 1 has been amended to include elements from Claims 7 and 13. Claim 1 is nonobvious over the references for the reasons discussed above.

Because Claim 1 is not *prima facie* obvious, and Claims 8-11 and 13-17 are dependent upon Claim 1, they are not *prima facie* obvious for the same reasons.

In light of the foregoing, Applicant respectfully requests that the Examiner withdraw the rejection of Claims 8-11 and 13-17 under 35 U.S.C. § 103(a) as being unpatentable over *Smalley* in view of *Kawamura* and further in view of *Hampden-Smith*.

4. New Claim

New Claim 63 has been added herein. No new matter has been added by virtue of this addition. Support for this claim is found in original Claim 1 and in the Specification, such as at page 5, lines 7-12 and at page 15, lines 14-22.

5. Conclusion

As a result of the foregoing, Applicant asserts that the Claims are now in condition for allowance.

The Examiner is invited to contact the undersigned attorney at (713) 934-4094 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

WILLIAMS, MORGAN & AMERSON, P.C.
CUSTOMER NO. 23720

November 2, 2007

/Kenneth D. Goodman/
Kenneth D. Goodman
Reg. No. 30,460
10333 Richmond, Suite 1100
Houston, Texas 77042
(713) 934-4094
(713) 934-7011 (fax)

ATTORNEY FOR APPLICANTS